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SPREAD AND STABILITY OF ORNAMENTAL ALIEN PLANT SPECIES ON URBAN AND PERI-URBAN RIVERBANKS OF BUCHAREST, ROMANIA

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Abstract

Ornamental horticulture is one of the most significant pathways for the introduction of alien plant species globally. Many ornamental species, initially cultivated in gardens, have demonstrated invasive potential and begin their spread in riparian habitats. While a majority of these introduced plants have not yet become naturalized in local ecosystems, some species exhibit significant invasive potential under favorable environmental conditions or climate change.
This study examines the occurrence and stability of alien ornamental plant populations along the riverbank zones of urban and peri-urban waterways in Bucharest, focusing on the Argeș River, Dâmbovița River, and Colentina lake chain. The results highlight the presence of species with varying degrees of invasiveness in Romania, including, Ailanthus altissima, Alcea rosea, Hemerocallis fulva, Humulus scandens, Ipomoea purpurea, Reynoutria japonica and Solidago canadensis. These species have established stable populations influencing local biodiversity. The analysis brings into focus key aspects such as introduction pathways, invasion status, spread mechanisms, distribution across the three rivers, and relative abundance, offering valuable insights into the dynamics of alien plant invasions within urban and peri-urban riverbanks.

Key words*: alien, horticulture, biodiversity, river, urban.*

INTRODUCTION

Urban and peri-urban riverbanks represent highly dynamic ecosystems that function as transitional zones between aquatic and terrestrial habitats (Richardson et al., 2007). These ecosystems are considered "critical transition zones" due to their susceptibility to both natural and anthropogenic influences, including the introduction of alien plant species (Ewel et al., 2001; Richardson et al., 2007). Their hydrological dynamism, frequent disturbances, and high connectivity facilitate the dispersal of seeds and propagules, creating opportunities to establish and spread alien flora (Priede, 2008; Rusnák & Kidová, 2022). Horticulture plays a significant role in shaping urban biodiversity, acting as a primary pathway for introducing and spreading alien plant species (Van Kleunen et al., 2018; Hulme et al., 2018). Many ornamental species, initially cultivated for their aesthetic and functional value in gardens and green spaces, have demonstrated the capacity to escape from cultivation and establish populations in riparian habitats (Raicu et al., 2024). Depending on their ecological adaptability, these species may either integrate into existing plant communities with minimal impact or exhibit invasive behavior, leading to significant ecological disruptions (Richardson et al., 2007).

The expansion of ornamental plant species along urban riverbanks is influenced by multiple interacting factors, including modified hydrological regimes, soil disturbances, and the presence of diverse seed dispersal mechanisms such as hydrochory, anemochory, and human-mediated transport (Säumel & Kowarik, 2010). While some species establish stable populations without significantly altering ecosystem functions, others can outcompete native vegetation, disrupt trophic interactions, and modify riparian habitat structure (Strayer, 2010). The ecological consequences of such invasions underscore the need for a comprehensive understanding of the mechanisms driving the establishment and persistence of alien ornamental species in riparian landscapes. This study assesses alien ornamental plant species' distribution, spread, and stability along urban and peri-urban river-banks in Bucharest and its surrounding areas. By mapping the occurrence of alien ornamental plant species along the Argeș, Dâmbovița, and Colentina lake chain and analyzing their reproductive and dispersal strategies, we seek to evaluate their long-term establishment potential and ecological impact. The findings of this research can contribute to a deeper understand-ding of plant community dynamics in urban riparian ecosystems and provide valuable insights for biodiversity conservation and invasive species management in anthropogenic landscapes.

MATERIALS AND METHODS

Study area

The study focuses on the lower sections of the Argeș, Dâmbovița, and Colentina Rivers, which are hydrologically interconnected in the Bucharest region (Figure 1). The Argeș River (350 km) originates in the Făgăraș Mountains and flows southeast, collecting the Dâmbovița River (286 km), which also originates in the Făgăraș Mountains and passes through Bucharest before merging with the Argeș at Budești locality. The Colentina Rivers, a tributary of the Dâmbovița, forms a chain of artificial lakes before joining it (Radu & Stoiculescu, 2010).

Survey

Observation points were established at 2 km intervals along the lower courses of the Argeș and Dâmbovița Rivers. For the Colentina River, one observation point was selected for each of its ten major lakes (Cernica, Pantelimon, Fundeni, Plumbuita, Tei, Floreasca, Herăstrău, Băneasa, Grivița and Străulești), given the difficult access due to the private properties surrounding them. In each site, vegetation was surveyed using 100 m² plots. Species abundance was initially estimated using the Braun-Blanquet scale, which was subsequently converted into percentage values representing mean abundance. The study was conducted in August and September 2023.

Data analysis

Species frequency was calculated as the proportion of plots where the species occurred, relative to the total number of plots per river, and was categorized as: very rare (<10%), rare (10-25%), moderate (25-50%), frequent (50-75%), and very frequent (>75%). General frequency was determined across all rivers. Mean abundance was calculated as the average percentage cover in the plots where the species was present. Abundance categories were defined as follows: very low (<1%), low (1-10%), moderate (10-30%), high (30-50%), and very high (>50%). Additionally, species traits were recorded for each taxon, including invasiveness status in Romania, commercial use in Romania, life form, biogeographical origin, seed dispersal mode, and reproductive strategy (Raicu et al, 2024). These traits were used to assess ecological behavior and establishment potential across river banks.

In addition to trait-based and distributional analyses, a visual map was created to illustrate the spatial occurrence of ten selected ornamental alien species along the studied riverbanks. The selection was not based on frequency or abun-dance but rather on aesthetic and cultural rele-vance, as these species are commonly cultivated in green spaces and ornamental gardens due to their showy flowers (Figures 1, 2). To ensure clarity and avoid visual overcrowding, taxa with extensive distributions were excluded from the map.

RESULTS AND DISCUSSIONS

Species Inventory and Functional Traits

A total of 26 alien ornamental plant species were recorded along the banks of the Argeș, Dâmbovița, and Colentina rivers, each charac-terized by a set of functional traits (Table 1). Of the 26 taxa studied, 24 are marketed in Romania, especially for landscaping and decorative purposes in public and private green spaces. The species *Phytolacca americana, Reynoutria japonica,* are not for sale in specialty stores in Romania, perhaps because they have a high degree of invasiveness and are known from this point of view (Raicu et al., 2024).

More than half of the species (15 species) are classified as invasive in Romania (*Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Helianthus tuberosus*, *Humulus scandens*, *Lycium barbarum*, *Morus alba*, *Oenothera biennis*, *Parthenocissus inserta*, *Phytolacca americana*, *Reynoutria japonica*, *Robinia pseudoacacia*, *Solidago canadensis*). Others are casual (8 taxa) or naturalized (3 taxa) without being formally listed as invasive (eg, *Aesculus hippocastanum*, *Campsis radicans*, *Commelina communis*, *Hemerocallis fulva*, *Ipomoea purpurea*, *Salix babylonica*, *Symphoricarpus albus*) (Table 1).

The surveyed alien ornamental plant species exhibit diverse functional traits that reflect their potential ecological impact and adaptability to urban and peri-urban riparian environments (Table 1). Phanerophytes – including trees, shrubs, and lianas – represent the majority, with 16 species identified (e.g., *Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Fraxinus pennsylvanica*, *Lycium barbarum*, *Parthenocissus inserta*, *Robinia pseudoacacia*, *Salix babylonica* etc.). These woody plants generally exhibit high adaptability to disturbed environments and possess mechanisms for long-distance dispersal, often facilitated by human activity (Rundel et al., 2014; Pyšek et al., 2020). Hemicryptophytes are also well represented, with 5 taxa, such as *Alcea rosea*, *Helianthus tuberosus*, *Hemerocallis fulva*, *Phytolacca americana*, and *Solidago canadensis*, frequently characterized by rapid growth, high reproductive rates, and effective dispersal strategies (Popay, 2022). Additionally, 3 taxa were identified as therophytes or geophyte-hemicryptophytes (*Oenothera biennis*, *Reynoutria japonica, Commelina communis*), and 2 taxa as climbing annual (*Humulus scandens*, *Ipomoea purpurea*). The species *Humulus scandens* and *Ipomoea purpurea* exhibit vigorous growth and effective seed dispersal via water, wind, animals, and humans, enhancing their establishment potential along watercourses (Dumitrașcu et al., 2024; Astegiano et al., 2010). Biogeographically, most of the species originated primarily from North America (13 species) and Asia (11 species), regions recognized as major sources of ornamental plants in Europe (Van Kleunen et al., 2018). North American species, including *Acer negundo*, *Amorpha fruticosa*, and *Solidago canadensis*, have shown considerable invasive potential in European riparian systems due to their broad ecological tolerances and effective dispersal abilities (Richardson et al., 2007). Similarly, East Asian taxa such as *Ailanthus altissima*, *Reynoutria japonica*, and *Morus alba* demonstrate aggressive colonization abilities, significantly altering native community structures and ecological processes (Landenberger et al., 2007; Miroshnyk et al., 2025).

Seed dispersal mechanisms of the surveyed alien ornamental plant species include anemochory (wind dispersal), hydrochory (water dispersal), zoochory (animal-mediated dispersal), and anthropochory (human-mediated dispersal) (Table 1). Species such as *Fraxinus pennsylvanica* and *Ailanthus altissima* utilize primarily wind and water for long-distance dispersal (Säumel and Kowarik, 2013). In contrast, taxa such as *Elaeagnus angustifolia*, *Morus alba*, and *Symphoricarpos albus* exhibit zoochorous, often facilitated by birds, or anthropochore dispersal strategies, which enhance their potential for establishment in new areas (Richardson et al., 2007).

Most of the species exhibit both vegetative and generative reproduction, significantly increasing their potential for persistence and spread in dynamic riparian habitats. Species with efficient vegetative propagation via rhizomes or stolons - such as *Reynoutria japonica*, *Helianthus tuberosus*, and *Hemerocallis fulva* - are capable of forming dense monospecific stands, facilitating rapid clonal expansion even in the absence of viable seed production (Mandák et al., 2004; Barney et al., 2006). For instance, *Reynoutria japonica* spreads primarily through rhizome fragments and, despite limited sexual reproduction in many introduced populations, often reaches high dominance through vegetative means (Bailey et al., 2007). Similarly, *Helianthus tuberosus* propagates extensively through underground tubers, enabling rapid colonization of riverbanks and anthropogenic habitats (Abdalla et al., 2014). Field observations confirmed the presence of these two species at a single site along Lake Grivița (Colentina chain), where they form compact, expanding patches (Figure 2D). In the same location, *Helianthus tuberosus* was found growing in association with *Reynoutria japonica*, contributing to the formation of dense and persistent plant communities. Similarly, *Hemerocallis fulva* was recorded as an isolated population along the Argeș River, yet composed of numerous individuals (Figure 2H). It was located near semi-natural riparian vegetation dominated by

Rubus caesius, *Populus alba*, *Populus nigra*, *Salix* spp., *Cornus sanguinea*, and *Rosa canina*, suggesting a higher ecological compatibility with habitat type NATURA 2000 92A0 – *Salix alba* and *Populus alba* galleries.

Some taxa, such as *Campsis radicans* (Figure 2E), *Parthenocissus inserta*, and *Commelina communis* (Figure 2F), combine vegetative propagation (via layering or stem fragmentation) with seed reproduction, offering a dual strategy that enhances resilience to environmental stress and mechanical disturbance. *Campsis radicans* was observed expanding along the shores of Lake Plumbuita (Colentina chain), where it colonizes disturbed riverbank slopes. *Parthenocissus inserta* is relatively abundant on the banks of the Dâmbovița River, particularly in urban sections, and also occurs frequently along the Colentina riverbanks, often climbing over concrete banks. *Commelina communis* was recorded outside the urban core, along the Dâmbovița River near Chitila locality, where it grows within vegetation assignable to the *Rubi-Salicetum cinereae* association, indicating its capacity to integrate into semi-natural habitats.

In contrast, species such as *Ipomoea purpurea* (Figure 2G) and *Alcea rosea* (Figure 2C) rely predominantly on generative reproduction. Their seeds exhibit long-term viability, allowing them to persist in the soil and germinate when conditions become favorable, even in the absence of established adult individuals (Sohrabi et al., 2025). This reproductive strategy is well-suited to disturbed environments, where periodic substrate exposure facilitates seedling establishment. *Ipomoea purpurea* was observed with moderate abundance but low frequency along the Argeș River, growing both in human-disturbed zones and within patches of spontaneous vegetation, reflecting its ability to colonize a range of habitats through seed dispersal. Similarly, *Alcea rosea* was recorded on the banks of the Dâmbovița River, particularly in peripheral areas of Bucharest, where it was found growing in cracks between concrete plates along flood protection dikes. Its presence in these highly modified, ruderal environments highlights the role of seed persistence and germination in enabling colonization of artificial substrates and periodically disturbed sites.

Overall, the predominance of multiple dispersal vectors and mixed reproductive strategies among alien ornamental plants observed along Bucharest's urban and peri-urban rivers underscores their high ecological plasticity and potential for long-term establishment. These functional traits collectively illustrate why ornamental alien species have successfully established populations along the riparian habitats studied. Understanding these traits provides crucial insights into their potential ecological impacts and aids in the development of effective management and conservation strategies in urban riverine ecosystems (Pyšek et Prach, 1993).

Distribution Patterns and Abundance

Alien species distribution varies substantially among rivers, influenced by urbanization intensity, habitat connectivity, and riparian management (Guida-Johnson et al., 2017). Colentina showed the highest species richness (17 taxa), followed by Argeș (15 taxa) and Dâmbovița (13 taxa) (Table 1)

Table 1 also presents the frequency and mean abundance of each species along the three rivers. Several species demonstrated strong patterns of establishment:

- *Humulus scandens* was found in 16 plots on Dâmbovița (40%) with a very high mean abundance (55%), but was much less common on Argeș (10 plots; 20%) and rare on Colentina (10%).
- *Ailanthus altissima* occurred widely, with 14 plots on Argeș (28%), 10 on Dâmbovița (25%), and 5 on Colentina (50%), suggesting high ecological plasticity.
- *Robinia pseudoacacia* formed dense stands along the Argeș River, particularly in peri-urban areas subject to human disturbance, where it reached abundance values exceeding 60% in several plots. In some cases, these occurrences were associated with former or existing *Robinia* plantations.
- Conversely, *Alcea rosea* and *Campsis radicans* were observed in only a few locations (5 and 1 plots, respectively), with low abundance (<5%).

The Colentina River, characterized by its artificial lakes and landscaped banks, hosted the most prominent ornamental species, like *Campsis radicans*, *Reynoutria japonica*, *Solidago canadensis*.

A better visualization of the spatial occurrence of the 10 most visually prominent ornamental alien species present on the riverbanks can be seen in the distribution map (Figure 1). The selected species refers to *Phytolacca americana* (Figure 2A), *Solidago canadensis* (Figure 2B), *Alcea rosea* (Figure 2C), *Helianthus tuberosus, Reynoutria japonica* (Figure 2D), *Campsis radicans* (Figure 2E), *Commelina communis* (Figure 2F), *Ipomoea purpurea* (Figure 2G), *Hemerocallis fulva* (Figure 2H), and *Oenothera biennis*. Their mapping highlights isolated but often strategically placed occurrences, typically near human settlements, gardens, or urban parks that facilitate accidental introduction and establishment (Barudanović et al., 2021). While these species currently show low frequency and localized abundance (Table 1), their spatial presence in accessible and dynamic urban-riparian mosaics may facilitate further spread under favorable ecological or anthropogenic conditions. Thus, Figure 1 serves not only as a visual tool but also as an early warning signal for species potentially transitioning from casual occurrence to broader naturalization.

The mapping results of the ten ornamental species highlight the proximity of several species identified along the studied rivers to protected natural areas. Specifically, *Alcea rosea* was found along the Colentina River near the protected area ROSCI0308 Lake and Forest Cernica, while *Hemerocallis fulva*, *Ipomoea purpurea*, and *Oenothera biennis* occur on the banks of the Argeș River close to Comana Natural Park (Figure 1). This spatial proximity may enhance propagule pressure, increasing the likelihood of invasive colonization of adjacent natural habitats (Fensham et al., 2013). Species such as *Oenothera biennis* and *Hemerocallis fulva* are already recognized internationally for their invasive potential in riparian ecosystems, capable of rapidly outcompeting native vegetation and altering community structure (Mihulka et al., 2006). Consequently, the presence of ornamental alien species near protected areas emphasizes the urgent need for continuous monitoring, preventive actions, and targeted management interventions to preserve biodiversity and ecosystem integrity in these vulnerable urban and peri-urban riparian zones.

The presence of ornamental alien species along the urban and peri-urban riverbanks of Bucharest highlights the dual ecological role of riparian zones: as both conduits for dispersal and hotspots of invasion. The patterns observed in this study confirm that horticulture remains a key pathway for the introduction of alien flora in European cities (van Kleunen et al., 2018). Species cultivated in gardens, parks, and roadside plantations can readily escape cultivation and establish in nearby natural or semi-natural areas, especially where disturbance, fragmentation, and hydrological connectivity create favorable conditions (Säumel & Kowarik, 2010; Castro-Díez et al., 2014).

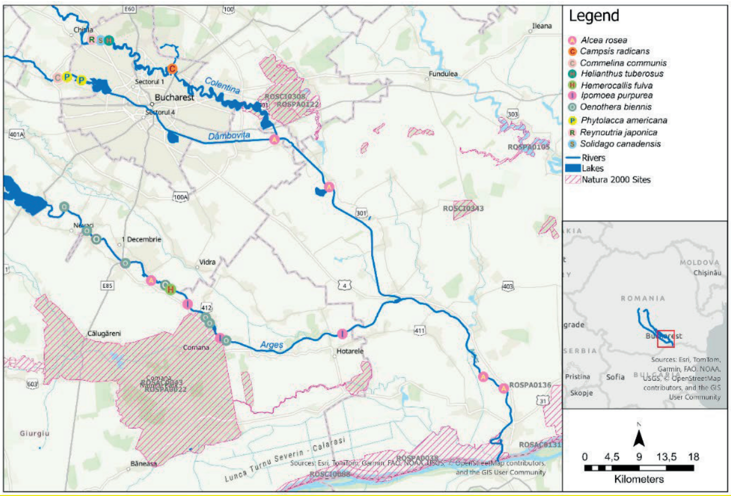

Figure 1. Distribution of selected ornamental alien plant species along urban and peri-urban riverbanks of Bucharest, Romania

Table 1. Functional traits, frequency and abundance of ornamental alien plant species recorded along riverbanks/

No.	Taxon	Inv. status	Life Form	Origin	Seed dispersal	Repr.	Frequency	Abundance
1	*Acer negundo* L	i	Ph	N Am.	An, Ap, Hy	V, G	AG: Rare (16.0%), DB: Rare (22.5%), CL: Moderate (40.0%), General: Rare (21.0%)	AG: Low (2.5%), DB: Low (1.5%), CL: Low (2.5%), General: Low (2.1%)
2	*Aesculus hippocastanum* L.	c	Ph	Balk	Ap, Z	V, G	AG: Very rare (0.0%), DB: Very rare (0.0%), CL: Very rare (10.0%), General: Very rare (2.0%)	AG: Very low (0.0%), DB: Very low (0.0%), CL: Low (5.0%), General: Low (5.0%)
3	*Ailanthus altissima* (Mill.) Swingle	i	Ph	As	An, Ap, Hy	V, G	AG: Moderate (28.0%), DB: Moderate (22.5%), CL:Rare (50.0%), General: Moderate (24.0%)	AG: High (16.88%), DB: High (15.56%), CL: Low (1.9%), General: High (11.98%)
4	*Alcea rosea* L.	c	H	As	Ap, Z	G	AG: Very rare (6.0%), DB: Very rare (5.0%), CL: Very rare (0.0%), General: Very rare (4.0%)	AG: Very low (0.5%), DB: Very low (0.5%), CL: Very low (0.0%), General: Very low (0.5%)
5	*Amorpha fruticosa* L.	i	Ph	N Am	An, Hy, Z	V, G	AG: Moderate (28.0%), DB: Moderate (12.5%), CL: Rare (30.0%), General: Moderate (20.0%)	AG: High (16.88%), DB: High (24.5%), CL: Low (2.0%), General: High (16.19%)
6	*Campsis radicans* (L.) Bureau	c	Ph	N Am	An, Ap, Hy	V, G	AG: Very rare (0.0%), DB: Very rare (0.0%), CL: Very rare (10.0%), General: Very rare (2.0%)	AG: Very low (0.0%), DB: Very low (0.0%), CL: Low (5.0%), General: Low (5.0%)
7	*Commelina communis* L.	n	T	Temp As	Ap, Hy, Z	V, G	AG: Very rare (0.0%), DB: Very rare (2.5%), CL: Very rare (0.0%), General: Very rare (0.5%)	AG: Very low (0.0%), DB: Very low (0.5%), CL: Very low (0.0%), General: Very low (0.5%)
8	*Elaeagnus angustifolia* L.	i	Ph	As	An, Ap, B, Ez, Hy	V, G	AG: Very rare (4.0%), DB: Very rare (0.0%), CL: Very rare (0.0%), General: Very rare (2.0%)	AG: Very low (0.5%), DB: Very low (0.0%), CL: Very low (0.0%), General: Very low (0.5%)
9	*Fraxinus pennsylvanica* Marshall	i	Ph	N Am	An, Hy	V, G	AG: Rare (12.0%), DB: Moderate (42.5%), CL: Very rare (10.0%), General: Rare (24.0%)	AG: Very low (0.5%), DB: Low (0.74%), CL: Very low (0.5%), General: Low (0.71%)
10	*Gleditsia triacanthos* L.	i	Ph	N Am	An, Ap	V, G	AG: Rare (12.0%), DB: Rare (17.5%), CL: Very rare (10.0%), General: Rare (14.0%)	AG: High (6.67%), DB: Moderate (3.64%), CL: Very low (0.5%), General: Low (4.02%)
11	*Helianthus tuberosus* L.	i	H	N Am	An, Hy, Z	V, G	AG: Very rare (0.0%), DB: Very rare (0.0%), CL: Very rare (10.0%), General: Very rare (2.0%)	AG: Very low (0.0%), DB: Very low (0.0%), CL: Very low (0.5%), General: Very low (0.5%)
12	*Hemerocallis fulva* (L.) L.	c	H	E As	Ap, Hy, Z	V, G	AG: Very rare (2.0%), DB: Very rare (0.0%), CL: Very rare (0.0%), General: Very rare (0.5%)	AG: Low (5.0%), DB: Very low (0.0%), CL: Very low (0.0%), General: Low (5.0%)
13	*Humulus scandens* (Lour.) Merr.	i	T	E As	Hy	G	AG: Moderate (20.0%), DB: Frequent (40.0%), CL: Rare (10.0%), General: Moderate (26.0%)	AG: Moderate (17.9%), DB: Very high (55.0%), CL: Very high (87.5%), General: High (41.1%)
14	*Ipomoea purpurea* (L.) Roth	c	T	Trop-Am	An, Ap, Hy, Z	G	AG: Rare (10.0%), DB: Very rare (0.0%), CL: Very rare (0.0%), General: Very rare (4.0%)	AG: Moderate (8.3%), DB: Very low (0.0%), CL: Very low (0.0%), General: Low (8.3%)
15	*Lycium barbarum* L.	i	Ph	E As	An, Ap, Hy, Z	V, G	AG: Very rare (0.0%), DB: Very rare (0.0%), CL: Very rare (10.0%), General: Very rare (2.0%)	AG: Very low (0.0%), DB: Very low (0.0%), CL: Moderate (17.5%), General: Moderate (17.5%)
16	*Morus alba* L.	i	Ph	E As	Ap, Hy, Z	V, G	AG: Moderate (30.0%), DB: Rare (15.0%), CL: Very rare (20.0%), General: Moderate (22.0%)	AG: Low (4.88%), DB: Very low (0.5%), CL: Very low (0.5%), General: Low (2.85%)
17	*Morus nigra* L.	n	Ph	SW As	Ap, Hy, Z	V, G	AG: Rare (14.0%), DB: Very rare (7.5%), CL: Very rare (0.0%), General: Rare (10.0%)	AG: Low (2.92%), DB: Very low (0.5%), CL: Very low (0.0%), General: Low (2.0%)
18	*Oenothera biennis* L	i	Th	N Am	Ap, Hy, Z	V, G	AG: Rare (16.0%), DB: Very rare (0.0%), CL: Very rare (0.0%), General: Rare (6.0%)	AG: Low (1.94%), DB: Very low (0.0%), CL: Very low (0.0%), General: Low (1.94%)

No.	Taxon	Inv. status	Life Form	Origin	Seed dispersal	Repr.	Frequency	Abundance
19	*Parthenocissus inserta* (A. Kerner) Fritsch	i	Ph	N Am	Ap, Hy, Z	V, G	AG: Very rare (0.0%), DB: Rare (17.5%), CL: Moderate (70.0%), General: Moderate (28.0%)	AG: Very low (0.0%), DB: Moderate (8.79%), CL: Moderate (7.14%), General: Moderate (8.0%)
20	*Parthenocissus quinquefolia* (L.) Planch.	c	Ph	N Am	Ap, Hy, Z	V, G	AG: Very rare (2.0%), DB: Very rare (0.0%), CL: Very rare (0.0%), General: Very rare (0.5%)	AG: Low (5.0%), DB: Very low (0.0%), CL: Very low (0.0%), General: Low (5.0%)
21	*Phytolacca americana* L.	i	H	N Am	Ap, Ez, Hy,	V, G	AG: Very rare (0.0%), DB: Very rare (5.0%), CL: Very rare (0.0%), General: Very rare (2.0%)	AG: Very low (0.0%), DB: Very low (0.5%), CL: Very low (0.0%), General: Very low (0.5%)
22	*Reynoutria japonica* Houtt.	i	GH	E As	An, Ap, Hy	V (main), G	AG: Very rare (0.0%), DB: Very rare (0.0%), CL: Very rare (10.0%), General: Very rare (2.0%)	AG: Very low (0.0%), DB: Very low (0.0%), CL: Low (5.0%), General: Low (5.0%)
23	*Robinia pseudoacacia* L.	i	Ph	E As	An, Ap, B, Hy, Z	V, G	AG: Moderate (28.0%), DB: Very rare (2.5%), CL: Very rare (10.0%), General: Moderate (18.0%)	AG: Very high (13.0%), DB: Very low (0.5%), CL: Very low (0.5%), General: Low (10.3%)
24	*Salix babylonica* L.	c	Ph	E As	Ap	V, G	AG: Rare (12.0%), DB: Rare (7.5%), CL: Rare (30.0%), General: Rare (12.0%)	AG: Low (3.58%), DB: Moderate (14.3%), CL: Low (2.0%), General: Low (6.0%)
25	*Solidago canadensis* L.	i	H	N Am	An, Ap	V, G	AG: Very rare (0.0%), DB: Very rare (0.0%), CL: Very rare (10.0%), General: Very rare (2.0%)	AG: Very low (0.0%), DB: Very low (0.0%), CL: Very low (0.5%), General: Very low (0.5%)
26	*Symphoricarpos albus* (L.) S.F.Blake	c	Ph	N Am	Ap, Z	V, G (less)	AG: Very rare (0.0%), DB: Very rare (0.0%), CL: Very rare (20.0%), General: Very rare (4.0%)	AG: Very low (0.0%), DB: Very low (0.0%), CL: Very low (0.5%), General: Very low (0.5%)

Abbreviations: Invasive status (Inv. status) (in Romania): c- casual, n- naturalized, i – invasive. Life form: G – Geophyte, H - Hemicryptophyte, Ph – Phanerophyte, T – Therophyte, TH – Hemitherophytes. Origin: Am – America, As – Asia, Balk – Balkan Peninsula, Trop – Tropical, N – North, E – East, S – South, W – West. Seed dispersal: An = Anemochore, Hy = Hydrochore, Ap = Anthropochore, Z = Zoochore, Ez = Endozoochore, B = Barochore, Reproduction (Repr.): G = Generative, V = Vegetative, V (main) = Vegetative (mainly), G (less) = Generative (less...)

Figure 2. Representative alien ornamental plant species with high decorative value observed along urban and peri-urban riverbanks in Bucharest: (A) *Phytolacca americana*, (B) *Solidago canadensis*,(C) *Alcea rosea*, (D) *Reynoutria japonica* and *Helianthus tuberosus*, (E) *Campsis radicans*, (F) *Commelina communis*, (G) *Ipomoea purpurea*, (H) *Hemerocallis fulva*

The high occurrence of species such as *Ailanthus altissima*, *Amorpha fruticosa*, and *Humulus scandens* - all capable of vegetative spread - demonstrates the relevance of reproductive strategies in determining invasion success. Their frequent association with highly disturbed areas supports earlier findings that propagule pressure and human activity are major drivers of ornamental species escape (Essl et al., 2019; Pyšek et al., 2020). Interestingly, several species with strong horticultural value (*Campsis radicans*, *Alcea rosea*, *Hemerocallis fulva*) were recorded with low frequency, yet their distribution near human-modified landscapes may signal early stages of naturalization. This underlines the importance of early detection and monitoring efforts, particularly for taxa that are not yet widespread but possess traits associated with invasiveness. The distinct distribution patterns between rivers also reflect differences in land use and hydrological structure. The Colentina, with its string of urban lakes and recreational spaces, hosted a larger number of decorative species with low abundance but high aesthetic value, likely due to landscape plantings. In contrast, the more naturalized sections of the Argeș and Dâmbovița featured higher cover values of aggressive invaders such as *Amorpha fruticosa*, *Robinia pseudoacacia*, *Humulus scandens*, *Parthenocissus inserta*.

CONCLUSIONS

This study highlights the presence and ecological behavior of 26 ornamental alien plant species established along the riparian corridors of Bucharest. Our results show that both urban design and ecological traits shape the distribution and persistence of these species. Frequent and abundant taxa such as *Ailanthus altissima*, *Amorpha fruticosa*, and *Humulus scandens* demonstrate high adaptability and suggest a strong potential for long-term establishment and expansion. Conversely, species with restricted presence but high aesthetic value (*Alcea rosea*, *Campsis radicans, Hemerocallis fulva, Solidago canadensis* etc.) exemplify the risk of unnoticed transitions from cultivation to naturalization. The urban and peri-urban riverbanks of the Argeș, Dâmbovița, and Colentina rivers act as both entry points and dispersal corridors for alien ornamental plant species. While certain taxa remain limited in distribution, others exhibit traits associated with invasiveness, especially in disturbed or unmanaged riparian stretches. Tailored management interventions, based on site-specific data and continuous botanical monitoring, are needed to mitigate the risks posed by these species and to preserve the ecological integrity of riparian habitats in Bucharest.

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